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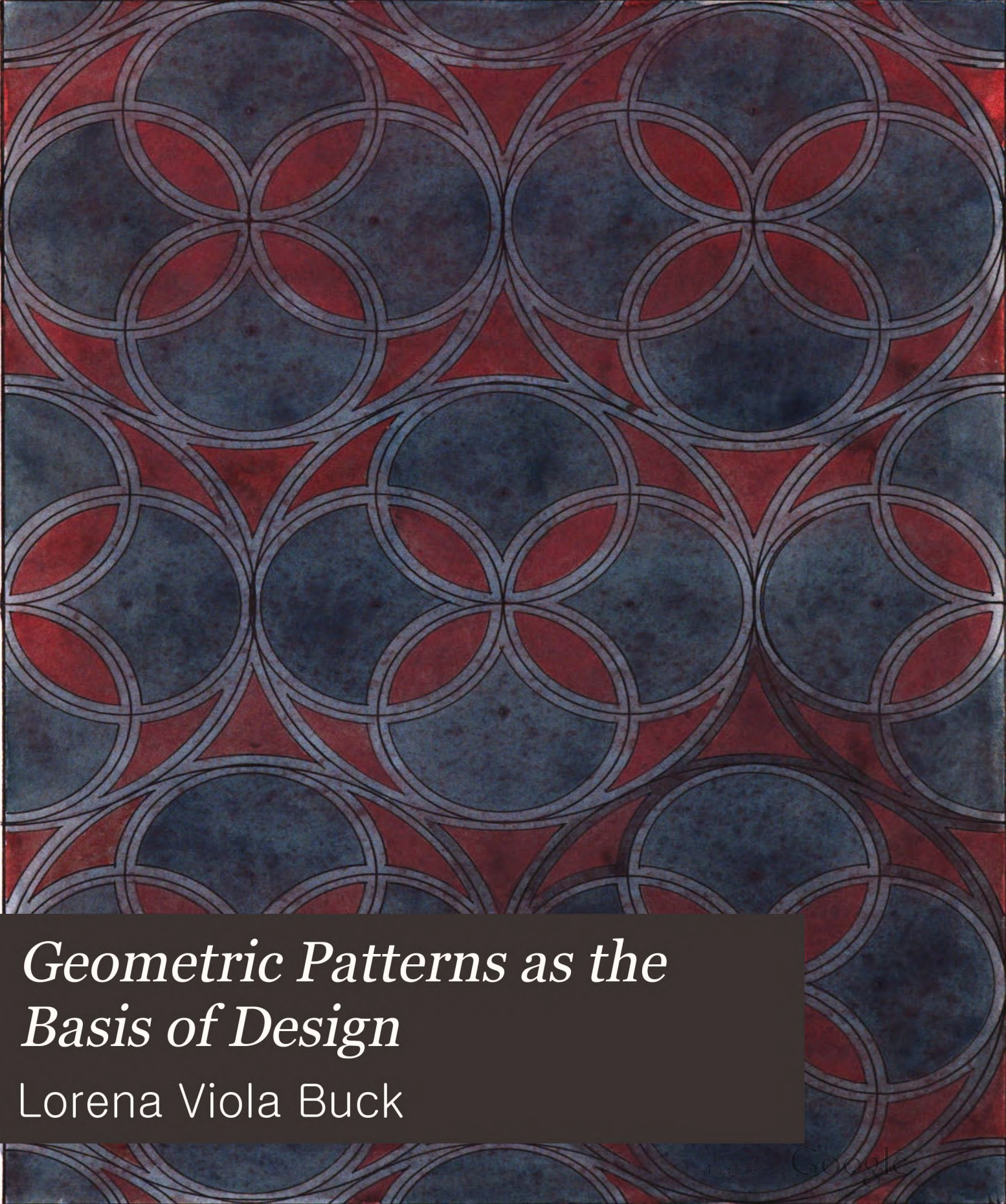

# *Geometric Patterns as the Basis of Design*

Lorena Viola Buck

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# GEOMETRIC PATTERNS AS THE BASIS OF DESIGN.

by

Lorena Viola Buck.

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts in the University of California.

Berkeley.

May 1915.

Approved
Eugene Neuhaus
May 4th 1915

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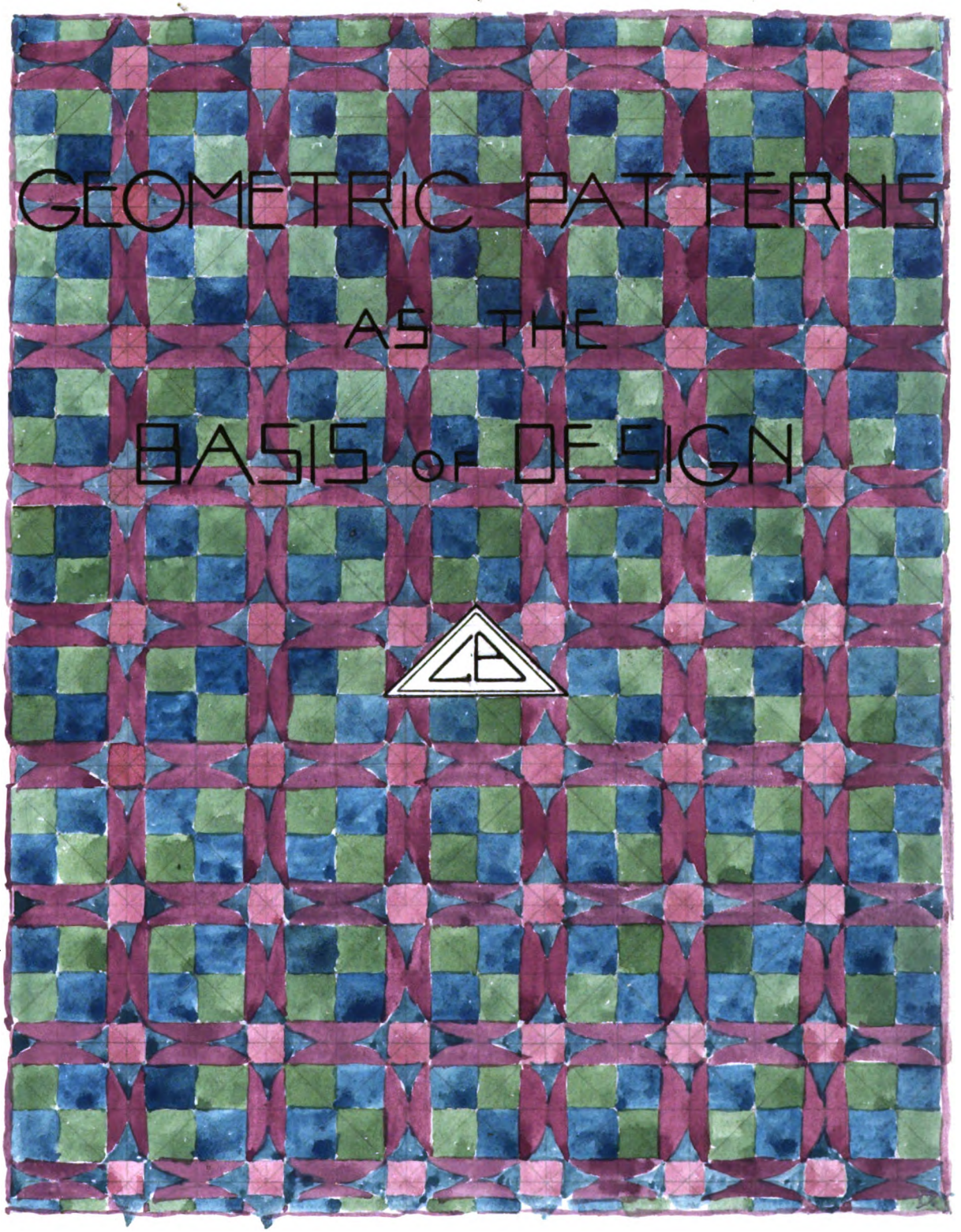


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## -: INTRODUCTION :-

The study of design,which occupies such a prominent place in the field of art,should be made by an analytical process similar to that by which sciences are approached; namely,to first examine and understand the nature of its basic principles by reducing the design to its simple elements,to evaluate these various parts,and finally,to gradually reestablish the coordination,thereby studying its structure and the separate and combined functions of its elements. The study of " Geometric Patterns as the Basis of Design" is such an analysis;for geometric patterns are the fundamental principles from which issue the means for the production of all forms of pleasing and agreeable lines,that is,for design.

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# Chapter I.

## GEOMETRIC PATTERNS DEFINED.

Before beginning the study of geometric patterns as the basis of design it is well to have a clear understanding of what is meant by the term "geometric pattern". Geometry is the science of magnitudes of space. Regarding pattern in its abstract sense and when used to depict natural forms, it is a single line, or a series or correlation of lines. Geometric patterns are then, single lines, or a series or correlation of lines which are governed by geometric laws.

A straight line is the simplest of geometric magnitudes, and it is also the basis of all ornament and design, the primal decorative unit. This simple element with its variations form numerous patterns, and especially form an important part of geometric patterns. However, geometric patterns are not entirely of the straight line type for the circle with its derived spirals and scrolls form a large part of the geometric world.

Pattern results from the repetition of simple units, and whether it be the result of simple weaving of reeds by primitive people or of elaborate present day machinery, we will find pattern if there is ordered repetition. And not only does pattern exist in man's physical world, but in the natural world also, for wherever we look find motives falling into pattern and giving rhythm and cadence. And

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although all are not obviously geometric in character those are essentially geometric which evolve themselves into design.

The possibilities of both the straight line and the circle are unlimited. The straight line may be placed at an infinite number of angles ranging from zero to ninety degrees in any direction and in reference to any plane, and at the same time may be combined with an infinite number of other angles at the same or various angles. Moreover, straight lines are combined to form figures or patterns, the lines and angles bearing geometric relation to each other. Lines placed at random without this relation would not form geometric patterns.

Three elementary figures comprise the principle forms which are used in combination. They are the triangle, the square, and the circle, together with their compounds, the hexagon, octagon, and ellipse. The triangle, the square, the pentagon, and the circle form the basis for all forms of curved or straight lines.

The circle, which is the most harmonious of all outlines is a perfect geometric pattern. It is used in its complete form or in part, as segments and arcs, and when used in part it is usually necessary to combine it with the straight line.

One should understand just what "pattern" means in the [illegible] field of decorative art, how little or how much it is in the control of the artist, and how it

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came into the world. The term is not used here in the sense of "a specimen" or a "shape or model for imitation", but is used to mean a unit of ornament. As a matter of fact, pattern has come to mean a repetition of forms at regular intervals in which lines of construction can be traced. Therefore the geometric note is introduced, for it is only when a geometric basis is used that the lines of construction, the backbone of the pattern are discernable.

The thought of design seems so very remote from geometry, which is so cut and dried, but nevertheless geometry does exist as the basis of design, and consequently it is well to understand what it is that is exposed in the dissection thereof.

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## Chapter II.

## THE MEANING OF DESIGN.

Pattern does not necessarily imply the existence of design;since one or more squares or circles may be said to be pattern. Design is something which is indicative of an idea converted into a definite fangible expression. Mr.Lewis Day has said that design is no mere overflow of a brimming imagination,but is cunningly built up on lines necessary to its consistency,and that the art of design consists not in spreading yourself over a wide field,but in expressing yourself within given bounds. And this brings out the relation between pattern and design,namely,that the controlling boundaries and basis upon,which design is built is pattern,the consistent lines of geometric pattern.

Given the controlling basis the design is created only as the designer possesses a sense of beauty. Imitation and repetition requires only industry and does not necessarily result in design,for design means something more. It implies inventive power and order in human thought and feeling,and an expression of a decorative unit posseseing certain qualifications of beauty,rhythm,and unity,

Primitive art consisted to a great extent in the mere repetition of simple geometric forms found in the natural world,but we cannot call all of such expression design. Later these geometric forms were connected by lines,demanding more thought and artistic expression. And

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so the process continued,more and more human expression being put into the work,until finally these fundamental patterns became the controlling boundaries for true design.

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## Chapter III.

## GENERAL CHARACTERISTICS OF PRIMITIVE DESIGN.

Primitive design, characteristic of primitive life in general, consisted of very simple elements. The music of primitive peoples was very simple. It consisted of the mere repetition of sounds struck from some crude instrument, lacking intricacy, yet withal possessing rhythm and charm which appealed to the people for whom it was made. Perhaps music was discovered through the sounds issuing from hollow reeds. So also we may possibly account for the birth of design. The hollow reed, so common to primitive life, must have made imprints on the sand and clay which could not have passed unnoticed, and doubtless many pleasing patterns were accidentally cast upon the soil by the circular ends of the reeds.

Moreover, we may say that geometric pattern grew out of the primitive modes of workmanship. The simple method which was necessary in plaiting and weaving gave rise to the production of pattern possessing the characteristics of repetition, regularity, rhythm, and coherence. The very process of weaving, void of any ornamental design, produces pattern, evident to the observer according to the coarseness of the weave. As workmanship became more refined through the increase of working tools and skill this natural pattern could, at will, be hidden by clever exterior patterns, but not effaced. However, many of the most pleasing

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results still lay in the fact that the geometric structure was frankly admitted and accepted as an artistic opportunity, to which any further ornamental pattern was added only to enhance the beauty of the texture.

Weaving and plaiting being a necessary process before the days of skill in mechanism, it is only natural that the basic elements of design should be early instilled in the consciousness of the race. But weaving and plaiting was not by any means the only source of learning in this art. The early Egyptians made a serious study of astronomy with its countless mysteries, and although it is not known who it was who struck the first circle and discovered the compass, the heavens are full of geometric patterns which man had but to copy as ornamental design in his earthly home. And doubtless in his study of the stars, the sun, and the moon, many geometric patterns were consciously or unconsciously evolved into design.

The necessity of surveying the fields of the country of Egypt after each inundation of the Nile demanded a knowledge of geometry, and therefore geometric patterns were brought to the attention of the Egyptians. However it is very doubtful that they made use of the compass during very early times, for no examples are found of the circle divided into six equal parts, a result readily obtained by stepping the radius around the circle. Consequently they must have used string and points.

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The work of the earliest periods shows such characteristics as are readily identified with primitive life. Just as man existed with only the bare necessities,so his design and pictorial art strove to express only the essentials,vigorous lines of movement and life. The recurrence of familiar lines and forms and their general simplicity places them definitely in their proper period. This is t true of all periods of design,and the various styles can be classified according to the dominating type of line.

The basis of design in all countries has invariably been of a geometric character,a simple arrangement of lines forming a sound foundation. And the development of art in all countries has been proportionate to the degree with which these fundamental and underlying geometric arrangements have been mastered.

A keen appreciation for the beauty of symmetry has ever been present throughout all primitive times,regardless of the importance or non-importance which any particular ornament played in the field of art. Conservative though they were,in all primitive design men appear to have thought for themselves,to have been quiet and truthful in thought,design,and execution. And such principles as they stood for would greatly benefit modern day art,were they substituted for prevailing intricacy and delicacy of execution. To the men of ancient times the expression of their ideals came easily without conscious effort because

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they were not afraid of the work entailed in the performance of their tasks.

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A series of elements collected from specimens of primitive Rhodian pottery in the British Museum.

A.H.Christie:-Pattern Designing.

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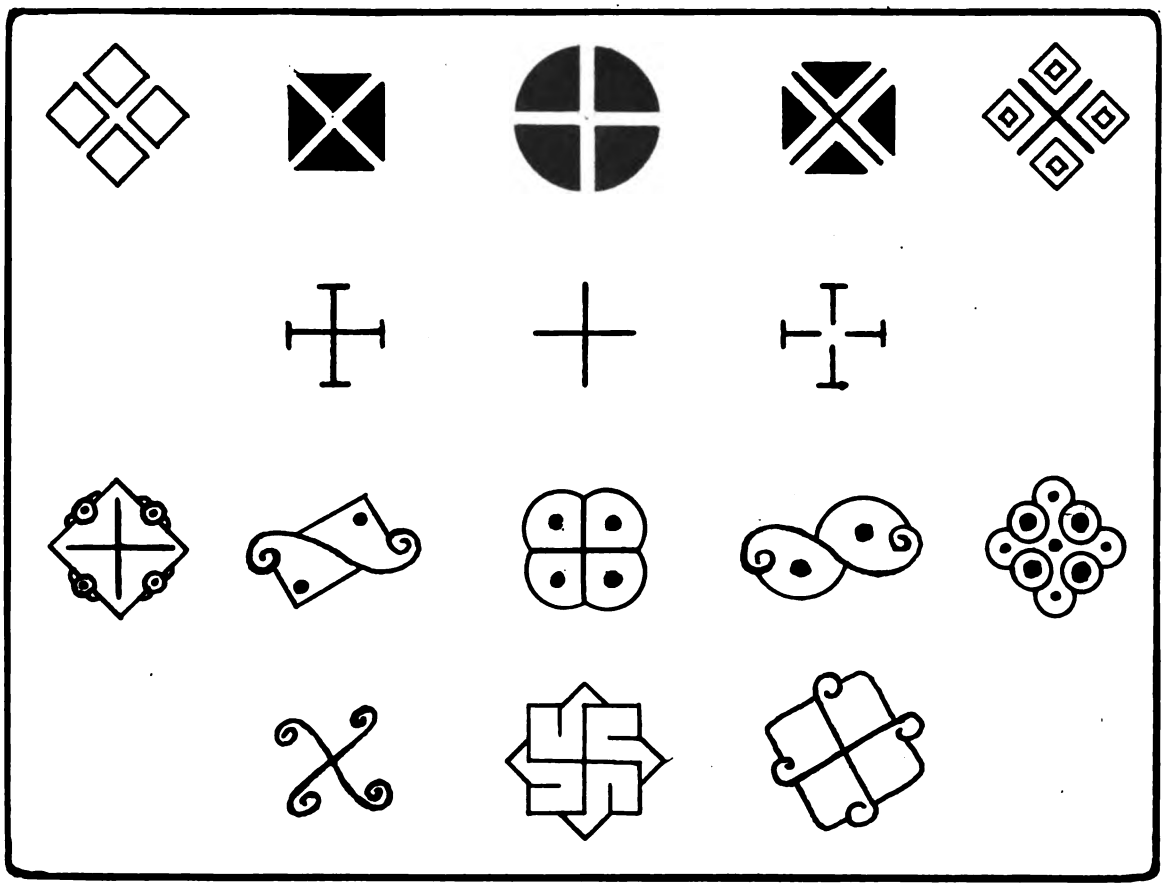

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An Analysis of Medieval Composition.

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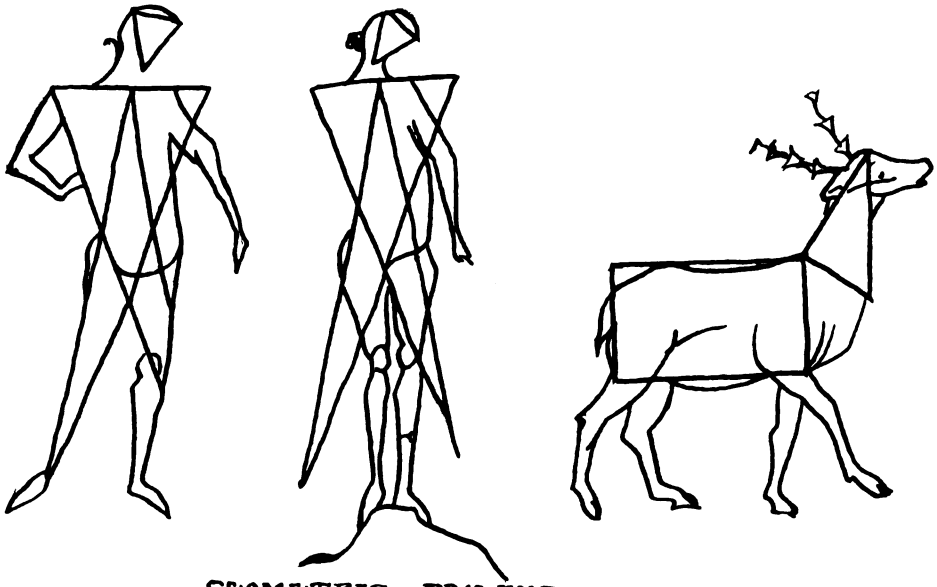

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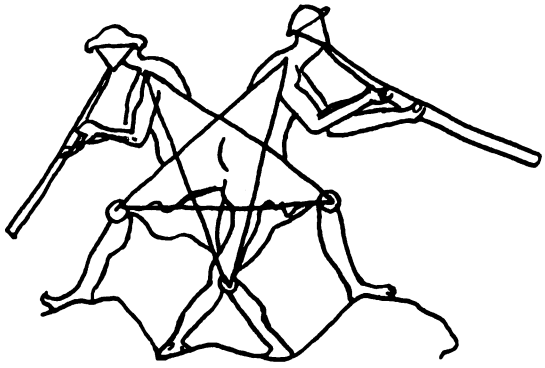

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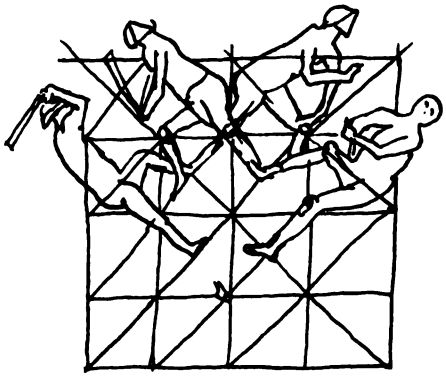

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AFTER DRAWINGS BY WILARS DE HONECORT

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## Chapter IV.

## SYMMETRY IN NATURE.

The necessity of a geometric basis for design is not an invention or a discovery of man. We have only to look to nature to see that there also it is a fundamental principle. Nature is developed with numerical and geometrical rhythm as its normal laws. There is much that is irregular in nature to be sure, but it may be said to be extraneous; for just as we introduce that which is irregular into a design built upon a geometric basis, so are the irregularities of nature dependent upon a firmer foundation although they in themselves seem a contradiction to the normal laws.

Mr. Richard Redgrave in an interesting treatise on the symmetry in the plant world makes the following remarks:

"Leaves are placed on the supporting stem either continuously opposite, or alternate or numerically recurrent; and as are the leaves, so are the future stems placed also. Again, varied quantity would be learnt from the study of nature; while it would be found that all vegetation is developed under a law of numbers; those numbers most largely prevail whose correspondent geometric forms give the greatest variety consistent with symmetry. Thus, three, corresponding with the triangle, is the law of inflorescence of all endogenous vegetation, whilst the flowers of oxogens are developed numerically as five, corresponding with

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the pentagon,much more largely than as four,the less varied root of the square;thus contributing to the largest amount of symmetry consistent with variety."

Moreover we are constantly finding that the cone, funnel,cylinder,and sphere are employed as essential and organic parts of the plant;and that all symmetrical flowers are constructed upon the geometric principle. The very unfolding of leaves and flowers in tendrils and vines express what Mr.Ruskin has called the infinite curve,that spiral curve having a rhythmic relation of measures.

But it is not only in the plant world that we find this geometrical symmetry,for we have only to think of the great constructive strength in the natural world,upon which is developed the beauty,harmony,and fitness which we so admire. Just as it is necessary for a good design to have a geometric basis,so do the geometric features in nature give to it life and growth. The sun's rays,the lines of the shells of the sea,the scales of the fish,and the feathers on the expanded wings of the birds all speak for the strength and character of the natural world. And so sound are most of the controlling shapes in nature that they may be safely employed as the basis of more or less artificial decorative design. And earnest students of nature throughout the whole world,of whatever period or position,will arrive at somewhat similar results in their ornamentation,due to the geometric elements and fundament-

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al principles upon which all art and nature are based.

But it nevertheless true that the closer we come to nature in design, the higher we ascend in the scale of life, the farther we should get from a complete symmetry. This does not mean to avoid geometric controlling principles, but to employ them for balance and unity rather than formal symmetry. The symmetry should be subordinated to these higher qualities. The essential basis of the human figure is symmetry, yet here it insures balance and unity of the various parts and is subordinated to them.

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An Example of Symmetry in Nature and its Application to Decorative Design.

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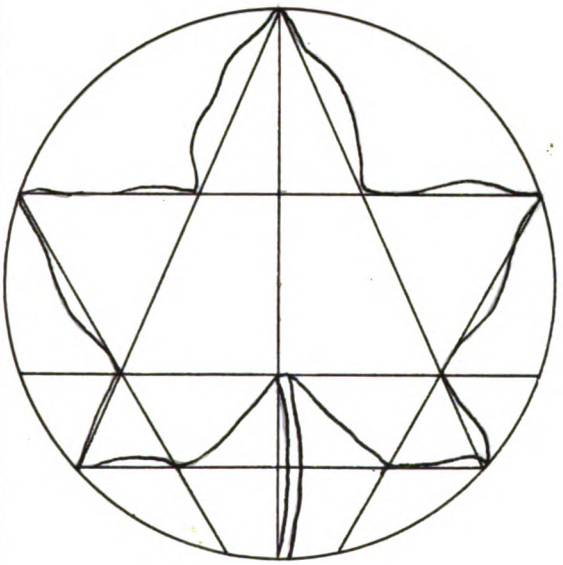

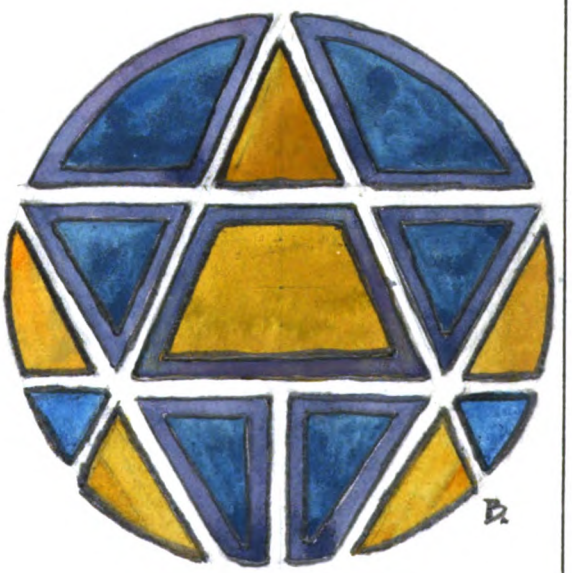

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## Chapter V.

## GEOMETRY AS THE BASIS OF ORNAMENT.

To set about designing ornamental patterns without considering the underlying logical construction is contrary to reason. But this is what is often done, and consequently we find much that is bad in all branches of ornamental work. This is especially true of much of our modern manufacturing of textile fabrics. Because the artist in setting out to paint a picture, or the sculptor to carve a statue is not absolutely governed by geometry as a principle upon which he must build the designer possibly feels that he also has a free field to wander as he will. But here he finds that he is mistaken, for although geometry is not essentially required as the basis of art it is the essential basis and governor of ornament, whether or not the designer acknowledges it.

The beauty of art, with the exception of that of ornamental basis lies in its picturesque and dissymetrical grouping and in its unequal quantities. On the contrary, geometry is the most important factor in ornament, particularly as it forms the basis of practically all surface patterns. Here beauty depends upon the symmetry and correspondence of parts.

It is in an attempt to acquire the unsymmetrical beauty of art that the designer may neglect those very principles most essential to its acquisition. With geo-

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metric patterns as the background of the ornament it is possible to obtain the desired unity, rhythm and coherence necessary to express the object of the ornament on the surface which it adorns. In no other way can this result be accomplished. Designing is not mathematics or geometry; neither is the designer governed by such strict structural laws as the architect; but laws exist, whether physical or mental which do not admit of neglect. And these very constructive necessities of architecture demand the control of geometric lines and spaces in design. Particularly is this true in the influence of Gothic architecture, for here the great variety of geometric spaces and forms demand ornament adapted to them, and the designer must necessarily depend on the governing geometric elements for the determination of the nature of his design.

The geometric basis may or may not appear to the casual observer in the finished design. It is, however the first element of the problem, and the designer may carry it throughout the design as a part of the decorative scheme, or it may be so relegated to the background that its presence is not evident or even consciously felt; but the very fact that the design is pleasing to the eye, that it possesses a sense of scale, harmony and rhythm, and that the lines fulfill the purpose of decoration verify the fact that it is built upon geometric patterns of severity and strength.

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Just as the human skeleton consists of a strong symetric framework of bones which is indespensible to the outward form and the organic whole, so is a geometric basis indispensible to ornamental work. And as a knowledge of the human skeleton is essential to the student of the figure, so are the functions of geometric patterns essential to the student of design. But although the character of the ornament and its power of repetition is governed by the plan, the designer has an unlimited field both in the choice of the geometric pattern and the variety and diversity of its treatment. Let the designer first establish the backbone of his problem and then proceed freely according to the conditions and ultimate purpose of the design.

The work of the designer proceeds at will with marked rapidity through all the stages of the evolution of design. At first the geometric patterns themselves formed the ornament, used as single units or in combination or subdivision. Later, as man progressed in artistic ability, they became the plan and controlling boundaries only. It It may be said that during the later evolution of surface decoration the plan was lost in a profusion of floral or other motive. But such was not the case in any good ornament, for even in the most naturalistic and apparently free floral ornament the geometric connections announce themselves through the process of repetition.

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It would be inconsistent in this day of production of ornament by machinery should we aim to create design without regard to the fundamental structural principles when they were deemed so necessary in the ancient times when ornament was created by handicraft labour. No matter how much we may strive to disguise it by our modern day methods of machinery all ornament of whatever kind contains some law of geometrical formation which takes place at recurring intervals.

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An Abstract Design With a Geometric Basis.

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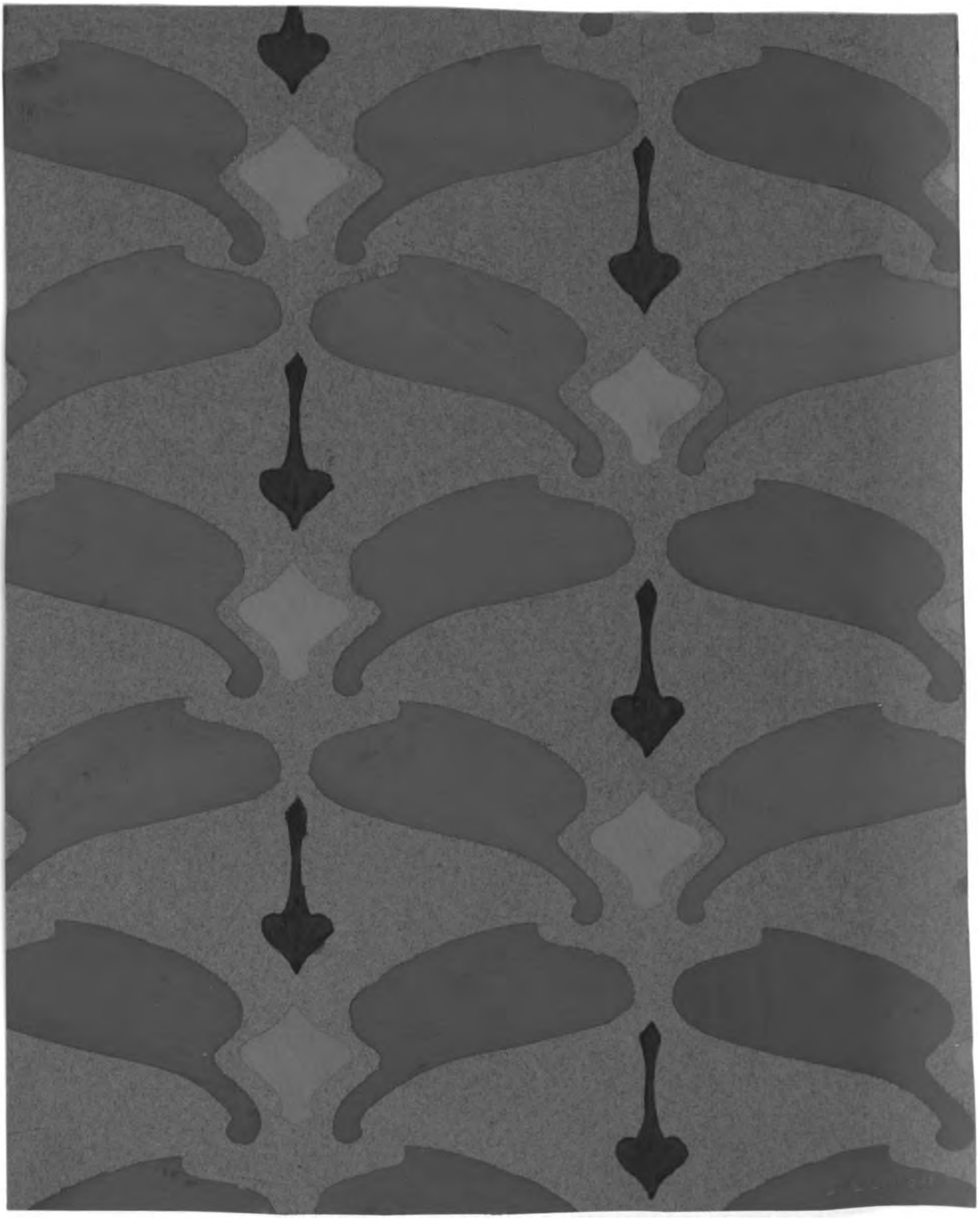

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## Chapter VI.

## GEOMETRIC UNITS AND THEIR USE.

### The Triangle.

The triangle,and especially the equilateral triangle,forms the basis of an infinity of pattern design. Its use is most apparent in Arabian design,and its extensive use here may be contrasted to the use of the square by the Western nations.

In the equilateral triangle we have the characteristics of a perfectly balanced pattern;balance on a center and symmetry on the vertical axis,together with measure harmony in the angles and in the lengths of the legs of the angles. Its very nature expresses stability,with its broad base,tappering to a point,and the center of balance remaining staple the while. It is little wonder then that it gives rise to a complex and ingenious variety of design.

Among the forms especially familiar in Arabian design,yet used to a great extent in all work even to the present day,are the hexagon,which is composed of six triangles,the star,the diamond,and other compounds of the triangle. The simplest of these is the diamond,which is composed of two triangles placed base to base. The ease with which these many patterns compound of the triangle doubtless accounts for their extensive use in Byzantine floor patterns,the Moresque,and in Indian lattice work.

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In this latter type we find that the designs resolve themselves into either of two forms; that of lines crossing in three directions or combinations of equilateral triangles.

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## The Circle.

Those qualities which we desire to find in a perfect design exist in united form in the circle, the most perfect and harmonious of all outlines. Here we find that the harmony is due to the uniform radius and angle measure existing in all sections, and to the harmony of distances, since all points on the circle are equidistant from the center of balance. Moreover, this balance center is unmistakably felt and gives to the figure a feeling of perfect measure and shape balance.

In spite of this the circle was considered by the early Egyptians to be too stiff and mechanical for general use, and no examples of its use are found in Egypt before the eighteenth dynasty. Great use was made of the spiral patterns because of their waving character, but as the spiral is one of the many offshoots of the circle they were unavoidably, although unconsciously, dependent upon it as their basis. However, some very beautiful types are found in later Egyptian designs, among which is that of contiguous non-intersecting circles, each containing four lotus flowers, the lotus being a favorite motive for design.

The patterns used by various countries and during various periods almost invariably denote the character and temperment of the people at the time of their use. Moreover, any type of decorative art to be lasting must convey some meaning. The use of the circle and its various

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subdivisions from their very nature denote the religious character, typified with few exceptions by the Gothic. The circle itself expresses eternity.

There is a well known practice of emplying curves, arches, and combinations of curves in such a manner that they form crosses in decorative design on churches and cathederals. This arose from the symbolism of Three in One which is composed of three circles combined on the three sides of a triangle, the triangle itself symbolizing the Trinity. And not only does every trefoil symbolize the Trinity and the circle Eternity, but every qauterfoil symbolizes the four evangelists, and the cross the Crucifixion. And since these simple geometric patterns played such an important part in religious symbolism it is not to be wondered at that they should form the basis of so great a variety of decorative design throughout the ages. Besides playing their part in purely decorative design on fabrics, embroideries, and interior and exterior decoration of all kinds, their influence is very apparent in architecture, as may be seen in the design of the windows, arches, domes and spires of churches and cathederals.

The usual way of employing the circles was to place them in squares. This was a somewhat restricted use however, and during the sixteenth century in Egypt the circle was treated as the basis for more liberal design, which at the same time shows the more liberal spirit of the Mediae-

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val period. Sometimes the circle was treated in a manner which clearly defined its existence,but more frequently it became the structural background,the solid and harmonious framework upon which more classic designs were built.

Just as the straight line is capable of infinite variations,so the circle may be treated in numerous ways which give rise to a wide variety of patterns and decorative designs. By combining the straight line and the circle great variety and contrast ~~and contrast~~ is readily obtained,and here also the variations are infinite.

It is in ancient Greece and Italy that we find the circle and its derivatives as a most perfect type,for here it seems figurative of the greater suppleness and sensitiveness to beauty,typical of those countries.

Among the offshoots of the circle the leading forms are the scroll,spiral,fan,and the oval,each of which are worthy of separate and careful study. In fact,upon the circle are based,to more or less degree,all compound curved figures;or we may say that the circle is the parent of all curvilinear variations.

The possible growth of the much used and well known Greek guilloche may be illustrated by the following series taken from Mr.G.W.Rhead's book on the Principles of Design.

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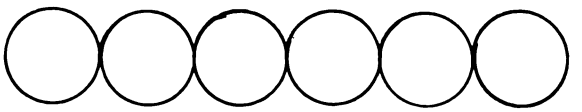
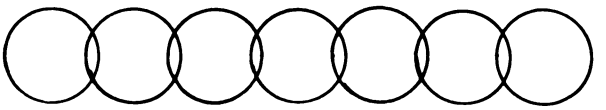
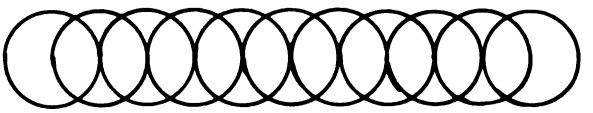
A simple sequence of circles just touching one another:-



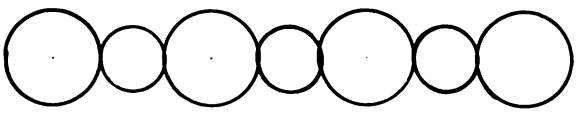
The slightly overlapping:-



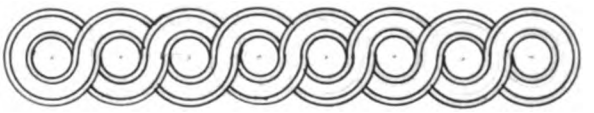
Then the overlapping of the circles just touching each other:-



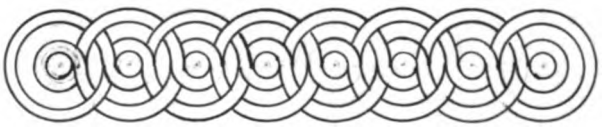
Then an alternate series of small and large circles;-



This leads to the large class of interlacing patterns formed on the circle, and also to the guilloche:-



From this to the strap design which may be called a broken double guilloche:-



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Mr.James Colling writes concerning compound curves as follows:-

"Much has been said about the subtelty and beauty of compound curves,and of the circular being the least beautiful;but why it is so is not very clear. The more subtle compounds,though beautiful when properly applied, are of exceptional use,and become possitively absurd wh - en improperly applied. That form is the most beautiful which is best adapted for the purpose intended and all beauty must be relative and depending upon the harmonious use made of certain elementary or compound forms Now,as the circle is used very much oftener than either of its compounds and the only form which probably is applicable it must be the most beautiful in all such cases. This occuring so continuously must necessarily raise it very high in the scale of beauty."

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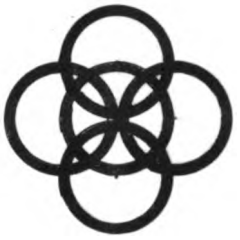

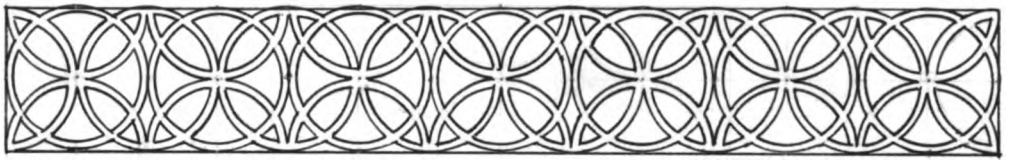

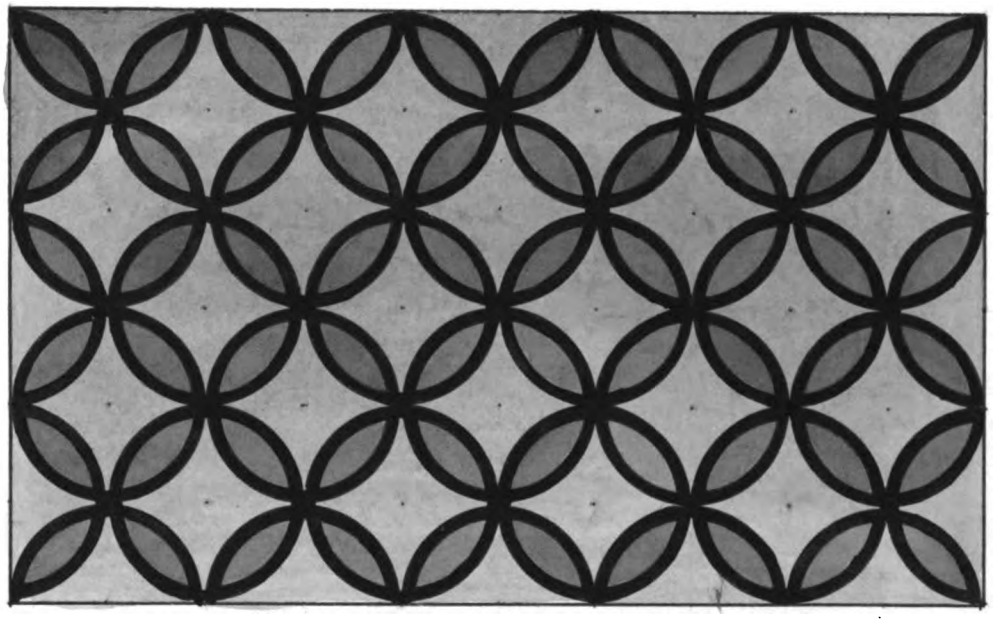

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An All-over Design Based on the Circle.

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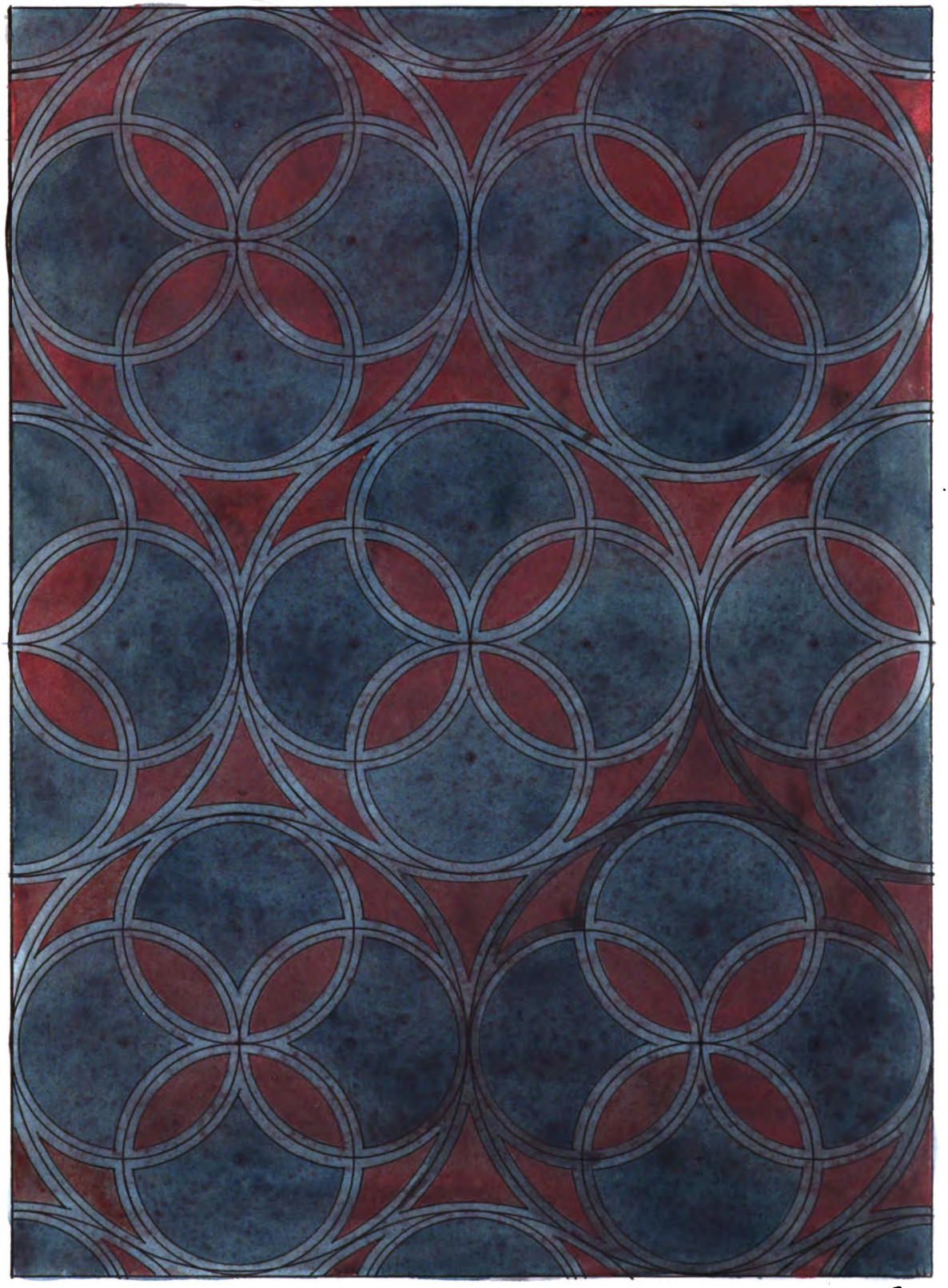

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Details From Notre Dame Cathedral at Paris.

Showing the Influence of the Circle.

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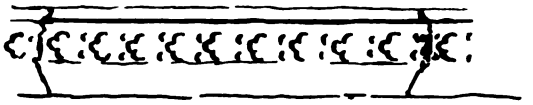

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## The Square.

The square and the circle may be said to be the parents of design, each differing to a certain degree in its fundamental role. Just as we look to the circular form for the embodiment of perfect harmony and grace in all its parts, so we look to the square and its rectangular variations for their particular functions. All angular variations in the degrees of direction of line lie between the vertical and the horizontal, and as the square embraces all of these degrees we may say that it is the parent of angular variation.

The square and the cube express the constructive necessity, stability. Along square lines seems to be the most natural path for thinking out a design, due to the instinctive desirability for establishing a solid basis upon which to build. Not only is this true when we are planning on paper some decorative design; but also when we are constructing a building do we plan along cubical lines. Moreover, nature herself has established this basic motive, and noticeable among the examples are the construction of the honeycomb, crystals, and many cells in organic nature.

The simplest use of the square in design is the mere repetition and recurrence of its own form; and from this is developed the system of subdivision and extension; and thence a whole universe of decorative elements, extend-

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ing from the repetition of the square unit to the decorative design in which the square exists merely as the invisible basis.

Upon the square is based the development of the chequer and fret and all of their many variations. To this fact is due the similarity between these forms of ornament in all ages;for no matter how devious the modes of construction or the types of materials with which the designers labored,the use of the square as the basis prohibited any very wide difference between the finished product;as is illustrated by the various types of frets on page ..

So closely associated is the square and its derivatives with the work of Scandinavian and Gothic pattern work that it may said to be symbolic of the ornament of Northern nations.

A motive giving a very charming effect is illustrated on page . It is the motive seen over the entrances to the exhibit palaces at the Panama Pacific International Exposition at San Francisco. The design is based on the square,subdivided by diagonals and cross lines,and the lighting effect seen from within the palaces,and the decorative effect on the exterior are most delightful.

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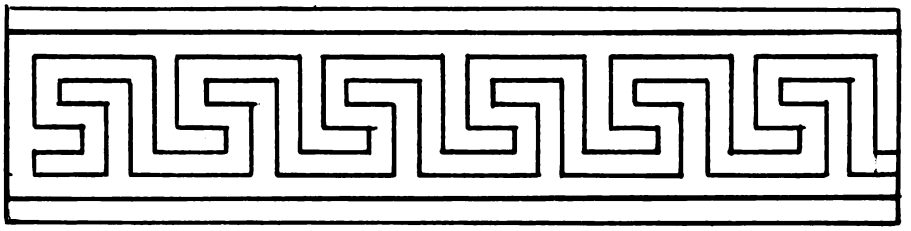

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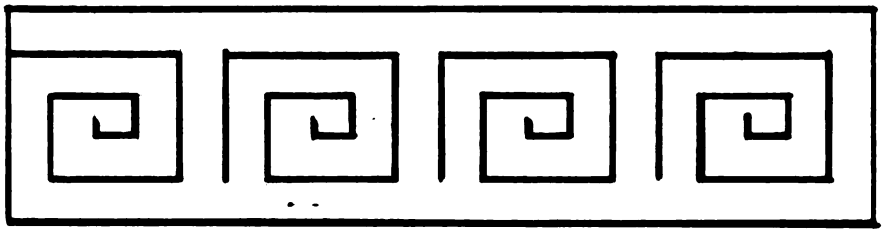

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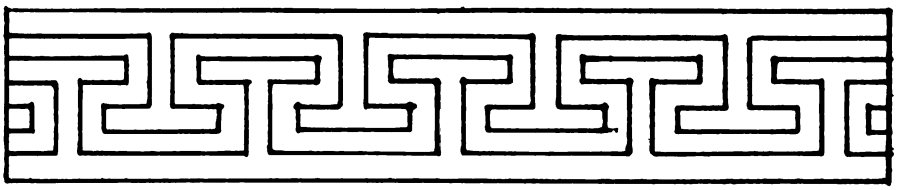
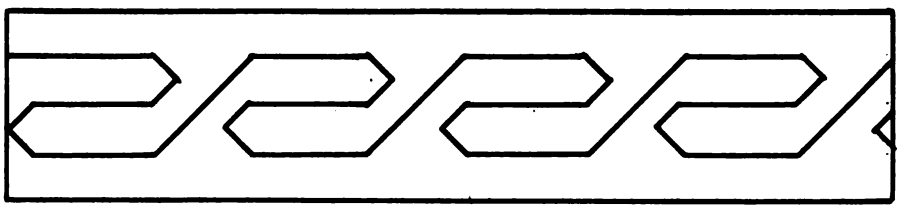
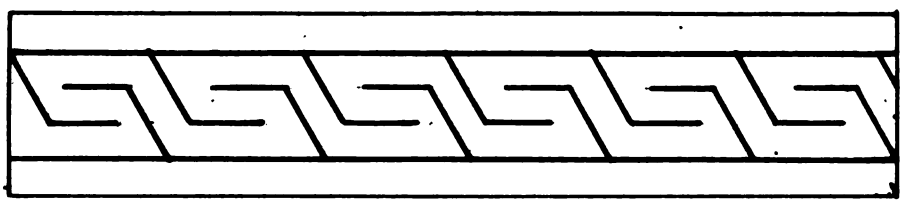


NORMAN



ARABIAN



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A Motive Based on the Square.

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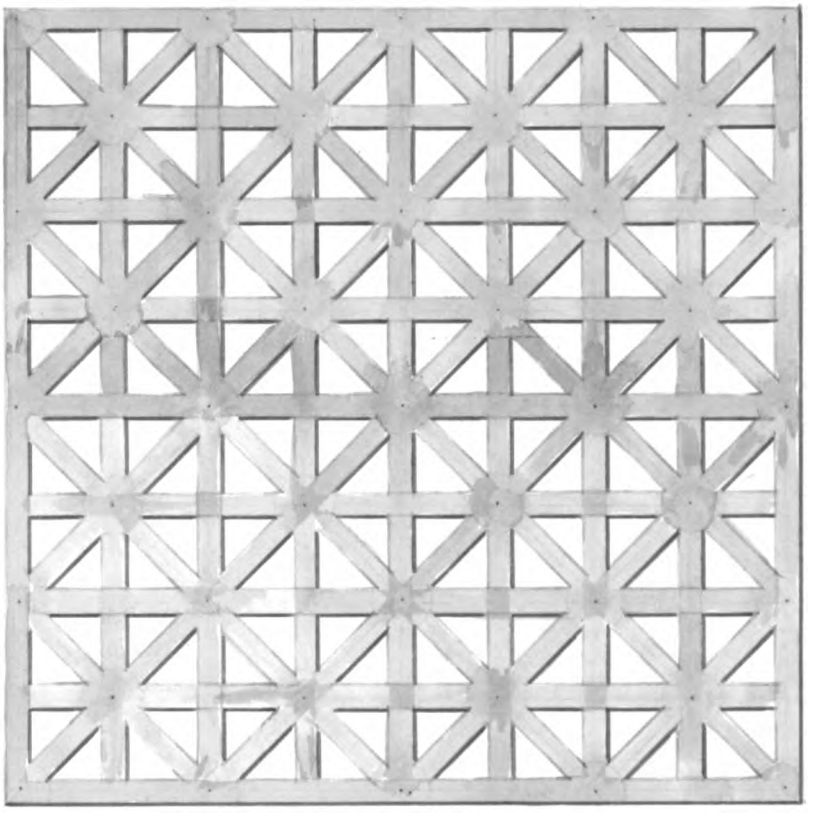

LIGHTING MOTIVE
OVER ENTRANCES TO EXHIBIT PALACES
PANAMA PACIFIC INTERNATIONAL EXPOSITION

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A Diaper Design Based on Overlapping Squares.

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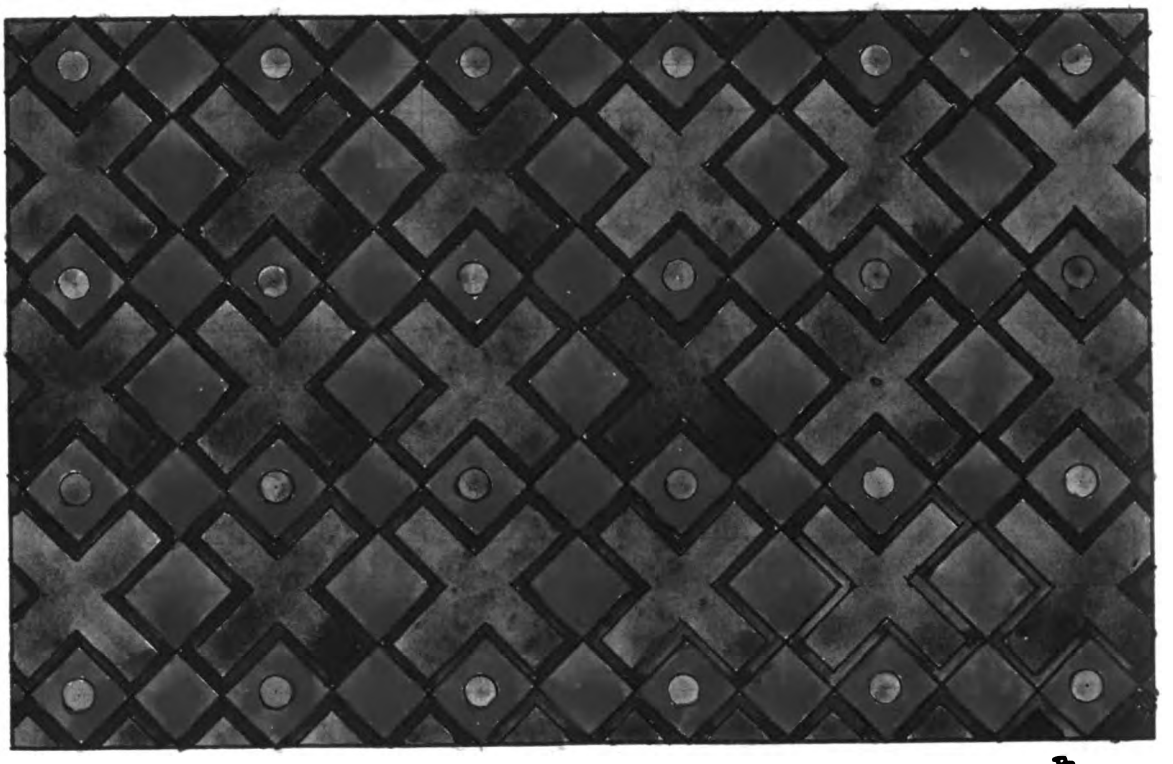

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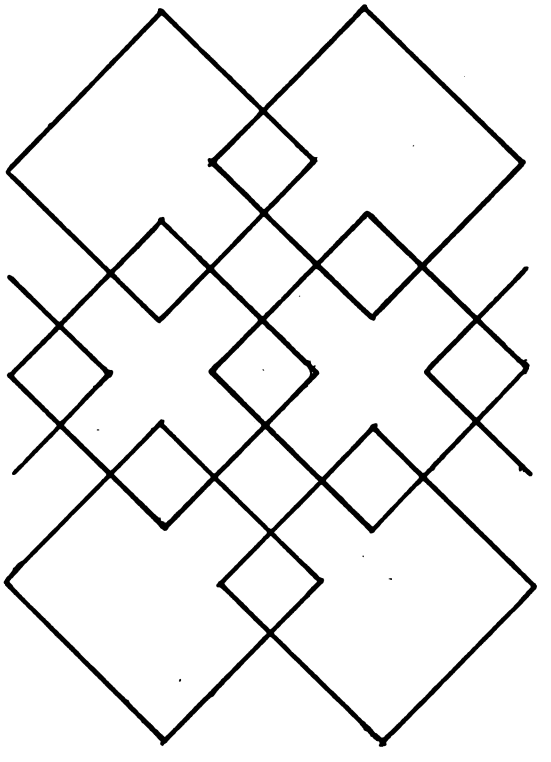

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# A Unit Based on the Square.

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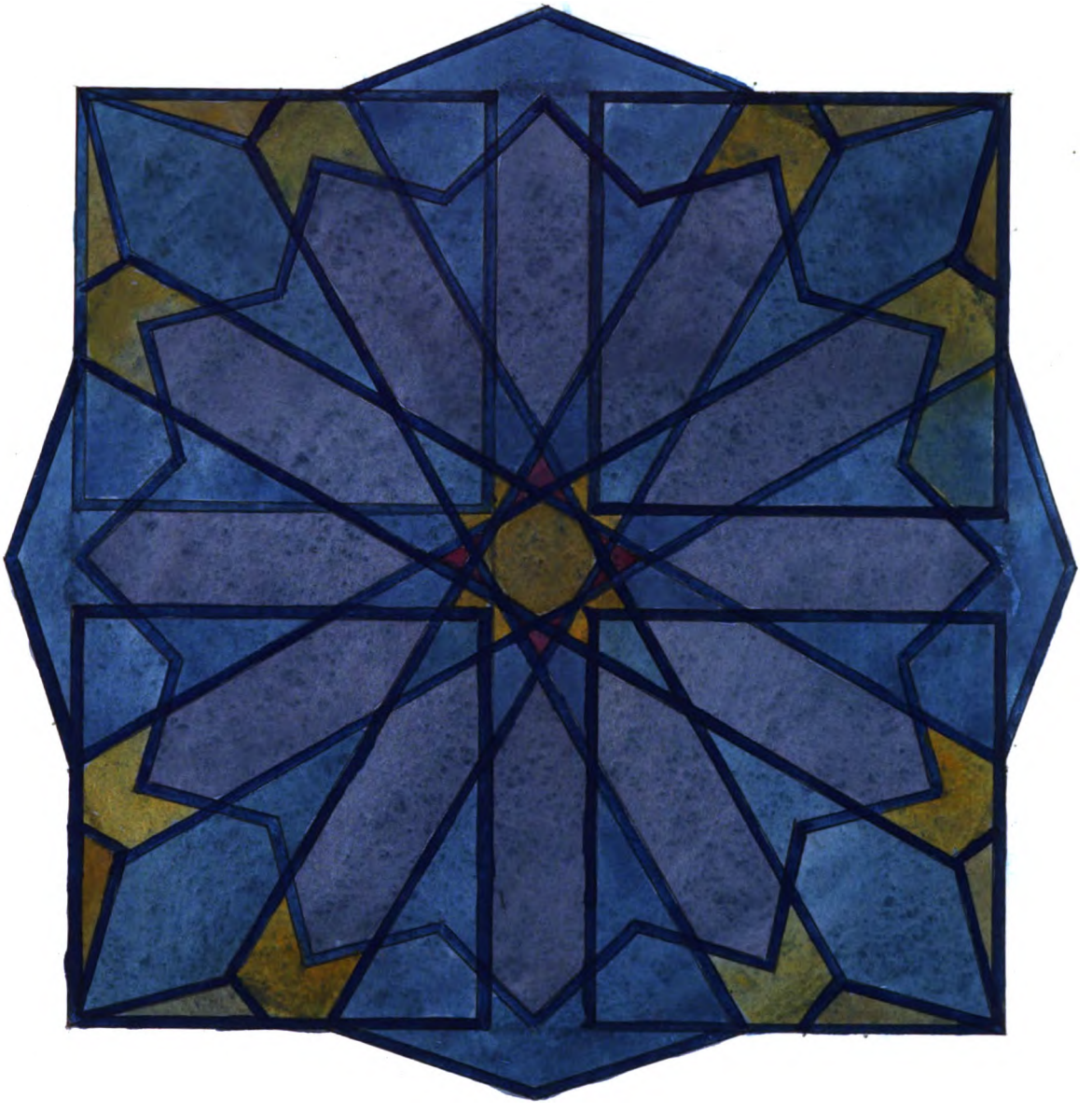

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## The Pentagon.

Departing from the square to the extent of adding one more side we obtain another type of geometric pattern, namely, that of the pentagon. And the pentagon represents the first of a field of polygons, ranging from the square to the perfect circle, and comprising an endless variety of design in the capacity of bases for elaborated ornament and as unadorned designs in themselves, either in series or compound form.

In flower and star forms in nature we find the pentagon more frequently than any other polygonal form. But although it is a beautiful form in itself it is less adapted to surface decoration and ornamental design than those variations having an even number of sides, due to the fact that it does not combine easily.

As the polygon increases in number of sides the design becomes more complicated, but no new principles are involved, and even though the pattern may have as many as sixteen or eighteen sides with their cross lines, it is still an offspring of the pentagon, or further still, of the square.

The hexagon and the octagon are more frequently used than the pentagon, due to their even number of sides and the ease with which they combine for surface decoration, and because of the symmetrical basis which they form when used as the foundations for more elaborated design.

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## Chapter VIII.

## GEOMETRIC INFLUENCE IN THE DESIGN OF VARIOUS COUNTRIES.

It has been said that Egypt is the father of the world's ornament;and certain it is that Egypt has shown us a capacity for decorative design which has not been surpassed by any other country. Moreover,it may be said that this country had a two thousand years start in the field of design before Europe awoke to her possibilities.

To Egypt we are indebted for the origin of most of those familiar elements which cover our walls,floors,book-covers,and even the ornamental facades of beautiful buildings;and it is because Egyptian design was so strongly decorative that it has lived through the ages. Very little that was nonessential or superfluous was employed,and thus the many patterns have remained in their pure and wholesome state to charm the men of all times.

One might suppose that the imitation of natural forms would comprise the first and earliest form of ornamental design,but where nature in any way departed from geometrical form this was not the case. The earliest decorative elements of importance were angular waves or zigzags, chequers,and varieties of the spiral. The general aspect of the art of Egypt is represented by the straight line or the long sweeping slightly curved line.

The character of the country undoubtedly had much to do with instilling its characteristics into the minds

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and feelings of the designers,and consequently into the ornament. Perhaps the eternal pyramids can express the spirit of the country better than any other type of work. Here the idea of great stability together with simplicity is forced upon the observer by merely a few triangular planes which stand firmly upon the ground and taper majestically towards the sky. Such was the spirit of all design;grace being secured by essential lines,each element expressing its purpose and at the same time retaining that characteristic of all Egyptian design,simplicity strongly decorative.

The plain zigzag line is found on the earliest tombs,and so simple is it in geometric construction that one would expect its possibilities of variation to be played out in a short time. But the plain zigzag line was used down to very late times,and it was about two thousand years after its first use that several new variations were discovered,and it was not until about 1500 B.C.that waving lines were used in place of the angular ones. The zigzag lines were later placed one under the other so that their angles met and formed squares;and their were thus converted into borders,which were decorated in color and in black and white. The angles and squares were then combined in various ways to afford variation in decorative effects.

So strongly alive were the Egyptians to the advantage obtained by a well balanced harmonious superstructure

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that they employed the principle in their hieroglyphic writing,and the result was that they had the most beautiful writing in the world. For many of the sounds there were two different symbols,one wide and one narrow,and that one was employed which combined more harmoniously with adjoining forms.

Those rudiments of design established by the Egyptians were so purely essential to the whole field of ornament that it is only natural that the ancient Greeks should pursue their work along the same geometric lines,merely changing and elaborating the old forms in accordance with the spirit of their own country.

A few decorative devises,such as the anthemion and the acanthus,which owe their birth to the natural forms of the country may be said to be primarily Greek,but no country with ornament of as lasting and beautiful character as that of the Greeks could depart from the fundamental principle of employing the simple geometric forms as the superstructure for their work. And thus we find the Grecian borders and friezes based on those elementary patterns,the triangle,square,polygon and circle.

Differing from the Egyptian in certain native characteristics,the Grecian work did not indulge in broad sweeping lines,and seldom used designs of an all-over character. Mural decoration was usually confined within borders,and friezes laid out in geometric patterns. To build

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within squares was the typical process of designing ornament and one of the most lasting of this type is the Greek fret.

Severely simple as this fret may be it has endured throughout the ages as worthy of the most prominent places among our design. From the simplest of line shading to the most intricate colored plaited forms this fret has played its part in the world of ornament,for designers of all times have found it pleasing. And the very nature of the design seems to denote that it is a logical motive created by a logical people.

As well known as the fret is the Greek guilloche, and in this ornament we have a design based directly on the circle;and although more limited because of the nature of the basic pattern experiencing many variations,due in part to the influence of weaving,and enduring through all times. It attributes its origin to Egypt and also to Assyria,and may have been derived from the marking left by fibre cord when tied around clay pottery while drying; yet so simple is it in its construction that practically every country must sooner or later developed it for its use.

And as the fret is the logical offspring of the square,so the guilloche is the logical result of circle combination,as illustrated in the chapter six. The Greeks. recogni zed its beauty and simplicity and developed it f

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for their own use and subsequently for the use of the whole world, even to the present time.

The spiral is another important element in prehistoric decoration in Greece, and it may be attributed to a geometric pattern, the circle, and was first used in Egypt. Various writers attribute the origin of the spiral to different sources, but whether it was first found in nature, in the shells of the sea or in the lotus plant; or whether it was developed directly from the circle, or by any other means, true it is that the circle is the parent of all curvilinear forms.

Mr. E.A. Batchelder in his book on the Principles of Design says that the scroll is one of the simplest and most effective examples of relation of measure, and he demonstrates John Ruskin's method for constructing a beautiful curve by joining a series of straight lines bearing a fixed proportion to each other in such a way that the angle which each makes with the preceeding line is always the same; and then joining the extremities of the lines.

In the design of the Greek and Roman capitals and mouldings definite geometric relations are preserved as necessary for their beauty and truth. Segments of circles and ellipses being employed and definite ratios between the parts adhered to.

Among the ornament of the ancient world the designs on the Byzantine ecclesiastical vestments are interesting

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for their geometric basis. They are often decorated with crosses formed of four right angles arranged together. By employing a few minor variations very charming surface patterns were obtained, as illustrated on page The unit was called "the gamma" due to their resemblance to the Greek letter Γ.

In Arabian art we find an extensive use of the angle as a unit of design. Here the angle equal to one third of a right angle is generally used.

Of particular interest is the development of geometric design in Mohammedan art. In spite of the fact that geometric patterns are essential to true design their use was forced upon the people whether or not they saw their importance. For the representation of any human form, whether human, animal, or vegetable, was strictly forbidden by the Koran. Consequently, the Mohammendans employed geometric patterns almost entirely in their decoration. And many of them seem to be meaningless. On the other hand, life forms forms were conventionalized into geometric ornament and many remarkable results obtained.

The beautiful geometric Roman mosaics excavated at Pompeii should be mentioned as representing an excellent type of ornament. They usually consisted of combinations of geometric patterns and the straight line.

Mention should also be made of the English stucco work of the Elizabethan period for here we find a wide field of geometric panelling, fan tracery and pendentives.

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Indian design represents careful adherence to geometric principles. In the blankets, baskets, and pottery the American Indians particularly have shown remarkable ability in the development of space and mass relations; and such ability comes only from the use of geometric patterns as a basis.

To fully appreciate the truthfulness of Indian design one has only to think of the attempts of amateur basket weavers to imitate the art. To secure such charming rhythmical designs on their baskets and blankets it was necessary for the Indians to employ careful ~~careful~~ consideration of geometric spacing. And in cases where the designer has departed from this geometric division to allow greater freedom of expression, as has sometimes happened in the work on pottery, the aesthetic feeling is lost. However the Indian seems to be more restricted by geometric boundaries, and particularly by those of angular rhythm, than those designers who have attained a greater degree of culture and freedom in imagination.

In Chinese art we find the square fret which is so often associated with Greek ornament, and which is often attributed to them entirely. But the Chinese, as well as the Japanese and Moors, used it. As the first instances of its use in China dates back to about two thousand years before its use by the Greeks it doubtless was carried from Egypt or else originated by the Chinese themselves.

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The fact that the great Chinese teacher, Chinanpin, believed and taught the theory that trees, plants, and grasses take the form of circles, semicircles, or aggregation of half circles, demonstrates the fact that the principle of geometric patterns was present in the art of natural representation.

In considering the design of the Orient we think of the Japanese as having attained greatest prominence. And it has indeed reached such a state of development that it is worthy of deepest study.

The casual observer of Japanese art would say that it is not based on geometric patterns, and that there is very little that pretains in any way to the cut and dried ornament found in any other country. But careful students have demonstrated that the ornamental design of Japan is founded on the same fundamental principles as that of any other country or period. True it is that the Japanese ornament abounds in a fertility of invention, but at the same time the essential principles of design are seldom violated. Doubtless it is true that the geometric patterns are employed in a less obvious way than in the ornament of other countries and are used more purely as the basis for surface subdivision, rather than as units of decoration in themselves. However, as Japan developed in intellectual ability the people became more partial to geometric patterns, and the result was apparent in the increased nicety

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of construction and percision in their work.

The circle, typifying the religious aspect of life, is apparent in Japanese design. Mr.C.R.Clifford makes the following statement concerning the treatment of the circle and square in Japanese art.

"According to the Japanese the form of heaven was circular. Man is the crown of creation, and it is therefore the representation of life. Heaven is called the positive or male principle, while earth or water stands for the negative or feminine principle. The universe is the phenomenon of these principles according to the ancient Japanese. The form of the earth is expressed with the water on the lower portion of the square. By cutting this square from north to south we have a triangle, and this triangle represents the combination of the east and west, or the male and female. The triangle thus obtained is a standard by which flowers and plants are trained to grow."

And we find that the Japanese have retained the fundamental geometric principles in their design, at the same time developing them along independent and national lines, and expressing in their work the spirit of sincerity, dislike for sham, and trust in that which is true.

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Byzantine Geometric Unit and its Application to Surface Pattern.

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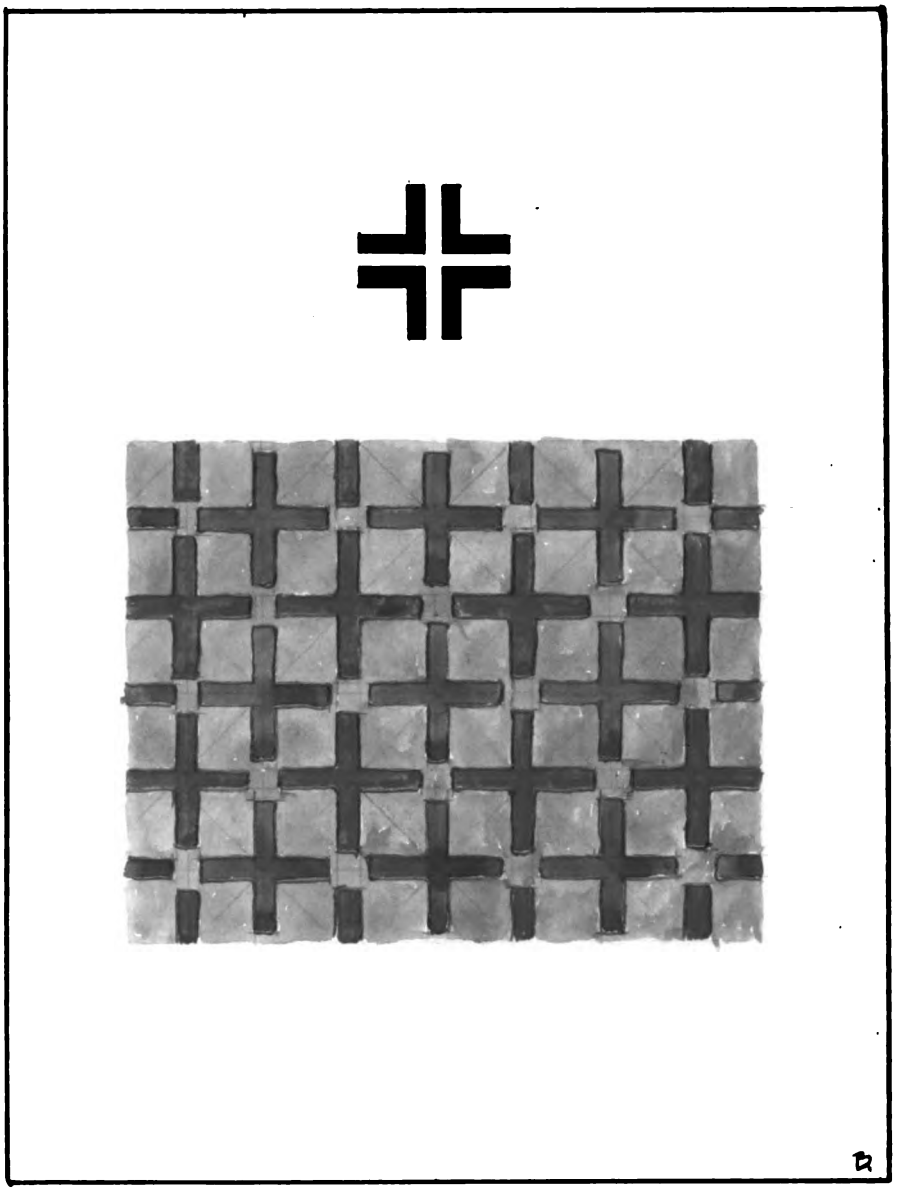

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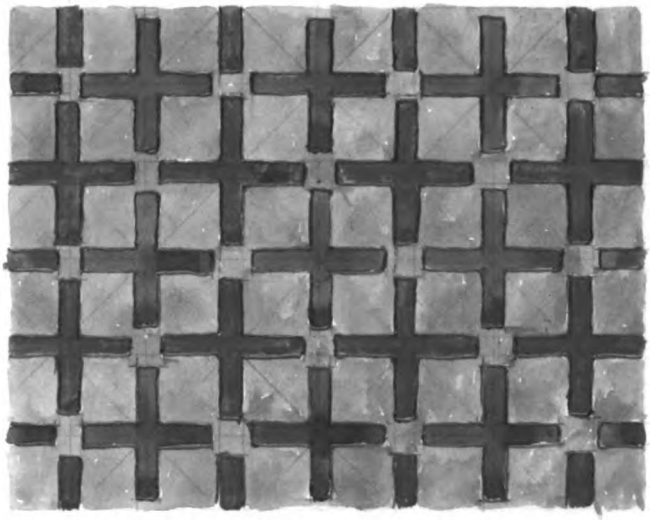

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## Chapter VIII.

## TYPES OF GEOMETRIC ORNAMENT.

The function of geometric patterns is chiefly confined to three distinct types of ornamental design, namely, diapers, borders, and centers; the latter type including all design radiating from a central axis. And each of these types is fundamentally dependent upon geometric lines and forms for its creation.

Diapers, or all-over patterns, are based on surface division. The space to be decorated must first be subdivided into smaller spaces. The network thus obtained may then be rendered in some desired manner or may serve as a foundation for foliated or other ornamentation. And consequently, the arrangement of geometric patterns in any one of numerous pleasing ways affords the best and only logical basis for the creation of diapers.

Because of the fact that they combine and cover a surface without leaving unequal interstices between them, we find the triangle and the square used more frequently in this capacity than the circle and the pentagon. But use must be made of the circle in order to obtain curvilinear effects, and consequently we find it in combination with the triangle and square oftener than with other patterns. And these three elementary forms give rise to an endless variety of diapers. It would be impossible to

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list the variations of which they are capable, for each shortening or lengthening of a side or radius, each change in the distances between figures, each new type of color treatment or thickness of line, establishes an ornament differing from the last. And each separate pattern may be divided within itself to change the general aspect of the design; as for example, the square may be complicated and altered by straight lines dividing its sides or by diagonals in one or two directions.

Of particularly charming effects are the large class of diaper patterns on fabrics. Here a geometric rather than a dispersed arrangement should prevail, and the patterns should be small and flatly treated, for large scattered patterns are not pleasing to the eye. The geometric patterns are not necessarily obvious, although essential as the skeleton; but very often even the simple geometric forms repeated regularly over the fabric produce charming effects.

Throughout the entire field of diaper work the tendency is to frankly confess the background of geometric patterns. The Oriental designer has never tried to evade this point, and sooner or later any craftsman who has scoffed at the idea of openly depending on this geometric basis has discovered his mistake; for it is the only logical path to pursue.

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The term "border" implies the repetition of form in one continuous direction;and therefore this type of ornament includes mouldings,friezes,margins,stringcourses, and certain types of panels,together with all types of ornament known by the term itself,borders.

The same principle which is applied to the formation of diapers is applied to borders. Here,repetition at regular intervals is the keynote of construction,and the same geometric patterns again form the basis of this repetition. One can scarcely imagine a pleasing border of any type which is not built upon a sound structural background.

The very nature of the term "border",or "stringcourse",or "frieze",implies that the ornament is held between comparitively narrow confines. The border may extend in any direction,however,as long as it remains within its limiting lines.

The designing of a border may start from a central axis and work outward in either direction until it reaches the limiting lines,or it may radiate from one or the other of these limiting lines and extend to the opposite side. However,the design is usually complete within these confines,the exception occuring in those borders which seem to have been taken as a strip from diaper patterns,and in such cases the limiting edges of the border seem to cut the design.

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The third type of ornamentation, because of the nature of its construction, may be called centers. In this type the geometric basis is least evident to the eye than in the other two types, but it is none the less important. The diaper ornament extends in all directions over a surface; the border in one direction and between limiting lines; but in this third type we have all of those designs which radiate from a central point or about a central axis and are not primarily limited in extent.

One of the earliest forms of this type of designing is found in Egypt in the representation of geometrical flowers, which are formed of circles radiating about a central point. And in fact, all conventional flowers are constructed on this plan.

The various units which are built upon the geometrical framework of diapers and borders, that foliage or other ornamentation, are of the class of centers. And so they are dependent upon geometric lines and forms for their consistency and truthfulness.

To insure balance and unity in the decoration applied to panels or any other individual unit of space, it is necessary to so plan the work that the design radiates either from a central point or axis line.

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## Chapter IX.

## CHARACTERISTICS OF A FINISHED DESIGN.

The first and most important characteristic to be sought in a design is that of rhythm, that action or movement which lends itself agreeably to the eye and carries it without confusion throughout all of the details of the design. Further, a sense of coordination and repose must be established which expresses the existence of a solid background and framework and a unity between the various parts. How are these desired characteristics to be obtained? The simplest method is that of employing some geometric shape at regular intervals for a repeated design, or as a single background for a design of only one unit.

To the designer is denied the freedom of range which the painter enjoys, for he must constantly bear in mind those governing elements so essential to his type of work. The painter may have many lines in his picture which are more or less nonessential. He may also have elements which immediately demand the attention of the observer, to the partial obliteration of all else. But a finished design differs in that no line can exist which is nonessential. Each line must be a part of the whole, bear a definite relation to the other elements in the design. Moreover, no one element should call forth attention, but rather it should be so related that the design as a whole blends into a delightful unity.

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Upon every design are placed certain limitations, and it is only within these limitations that the design should become a thing of beauty, complete in itself. The Parthenon may be cited as an example of a thing beautiful and complete within its limitations, and beyond this no design can go.

To secure the desired final result, the designer must have, at the beginning, a unit of measure from which the various stages in the growth of the design are developed. The unit of measure immediately does away with any tendency to introduce unnecessary details, and provides for those big broad proportions which give the feeling of harmony and rest.

The effect as a whole should be one of interest, and therefore some dominant mass or space unconsciously attract the observer. This mass must not, however, detract from the unity of the whole, but rather serve to prevent any monotony which might occur from all parts of the design assuming equal importance. Upon careful examination of a design it should be found that all parts have been subordinated to, and correlated with the unit of measure. And to insure the most perfect results some simple geometric pattern shpuld comprise this unit basis.

Unity and uniformity must not be confused in the mind of the designer. Mr. E.A. Batchelder has said that unity is the life of art and uniformity its death. However,

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this does not mean that a repeating unit of measure is to be avoided, but rather that it must exist to give unity. Its very presence brings unity, whether it be obvious or hidden to all but the most careful student. Uniformity would signify a series or combination of elements bearing little or no pleasing relation to one another. The very thought of uniformity gives a feeling of so many objects in a row, all looking alike and without any direct means of communication. Unity, on the other hand, is built upon these same objects, relating and harmonizing them, subordinating symmetry to higher qualities.

Throughout all the ages of design we find a strong inclination to avoid visible symmetry, although unity is generally secured. Giotta's tower may be cited as a remarkable example of symmetry overcome by unity. The unit of measure is the square, a unit severe and hard in itself, yet in this case where the squares are placed one above the other, the space relations are so designed that the whole effect is one of unity and architectural beauty. Many towers, churches, and temples may be analyzed and found to contain this same principle, that of overcoming uniformity by unity. The principle of unity is most essential in all architectural design, for here the geometric structural bases must be so related as to form an object pleasing to the eye as well as essentially useful.

Simplicity must be present in design to insure last-

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ing quality. The work of periods of design which has tended towards the over-ornate has not passed down through t the ages as examples of the greatest beauty. The simple Greek fret and the guilloche have existed through all times, and it is due to their simple geometric beauty and adaptability that they,and thousands of other designs bearing the same characteristics,will continue to be handed down from one generation to tanother. And to be durable a design must be built upon a geometric foundation,for it is only then that its form can be retained to any degree of its primary beauty. Even the simplest design is preferable to that which tends to express overabundance or the u unusual.

In producing unity it is necessary to take imto consideration the importance of tone value. The masses of light and dark determine the tone of the whole design. If the dark masses of the design are increased the tone of the design becomes darker,and if the light masses are increased the tone of the design becomes proportionately lighter.

The two types of balance must also be taken into consideration,namely,shape balance and tone balance. To insure tone balance the light and dark masses must be so selected and arranged that the unity of the design is preserved with no part being unduly emphasized. And of still more importance is the shape balance. Tone balance and

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shape balance together should give a feeling of repose, and consequently shape balance is necessary for this coordination. Here we find that equal attractions in symmetry must necessarily fall into some geometric relation with one another, and be grouped about a straight line axis or central point.

Geometric patterns again come into play in surface division. Assuming that a plane, such as a wall or floor, is to be decorated with design it must first be divided up into panels of definite geometric shapes. The same is true of curved surfaces, such as domes and vaults, and the same geometric patterns may be employed on them, but with different results. Lines which are horizontal on the plane surface form rings on the curved surface. The surfaces may be divided into rectangles, polygons, circles, or any number of a variety of geometric patterns.

The greatest care must be exercised in the selection of the elements of a design so that it is adapted to its use; and here again the geometric basis of the design plays its important role, for the plan declares the purpose. The treatment of this plan is then governed by the working material, the method of work, and the limitations placed upon the design.

A design intended for hanging must naturally be governed by different laws than one intended for a floor or ceiling. Moreover, it is obvious that a design intended

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for a running motive would need a new set of laws if intended for a diaper pattern extending in all directions over a large surface. But all are governed by the same fundamental law of geometric patterns as the basis, while each adaptation is merely governed by laws of formation which will best fit it for its particular purpose.

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## -: CONCLUSION :-

A clear understanding of the fundamental principles of design and their importance to line and form composition, together with the willingness to approach each new problem unhampered by tradition, yet willing to accept those governing principles which have lived throughout the ages, is essential for the sucess of all design. It was Viollet-le Duc who said:-"In order to live, Art must be free in its outward expression, though regulated as regards principles."

Sooner or later the designer discovers that design is governed by the laws of geometry and that his personal ideas must be built upon and conform to them. And so it is well that he understand this at the beginning, and accept what may seem to him a very round about method for obtaining his ideal, but which is in reality the simplest and safest way towards the realization of that ideal. The designer is not a person governed soley by his impulses and artistic feeling, and the sooner he gains this thorough knowledge of the fundamental principles the sooner he will be ready to receive the suggestions of nature and of his own imagination.

The beauty, the harmony, the usefulness, and all that is worth while in design lies in the hands of the designer, and it is for him to decide whether or not his work will strive towards a representation of that which is highest

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